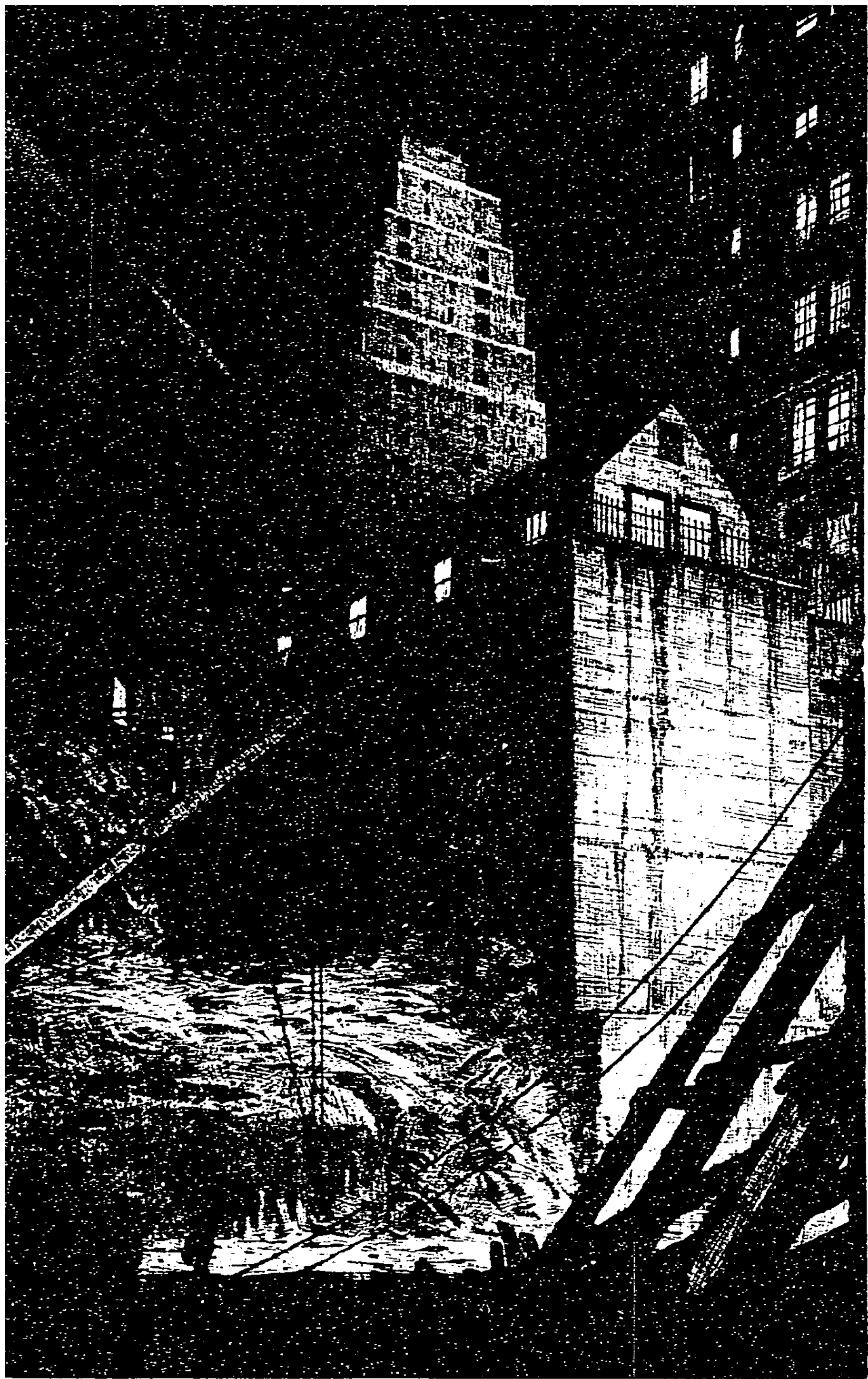


THE MIRACLE OF MOUNTING SKYSCRAPERS

Worked Out to the Last Detail, the Towers Shoot Upward With Almost Magic Speed



The Beginning of the Skyscraper Is a Man-Made Crater.

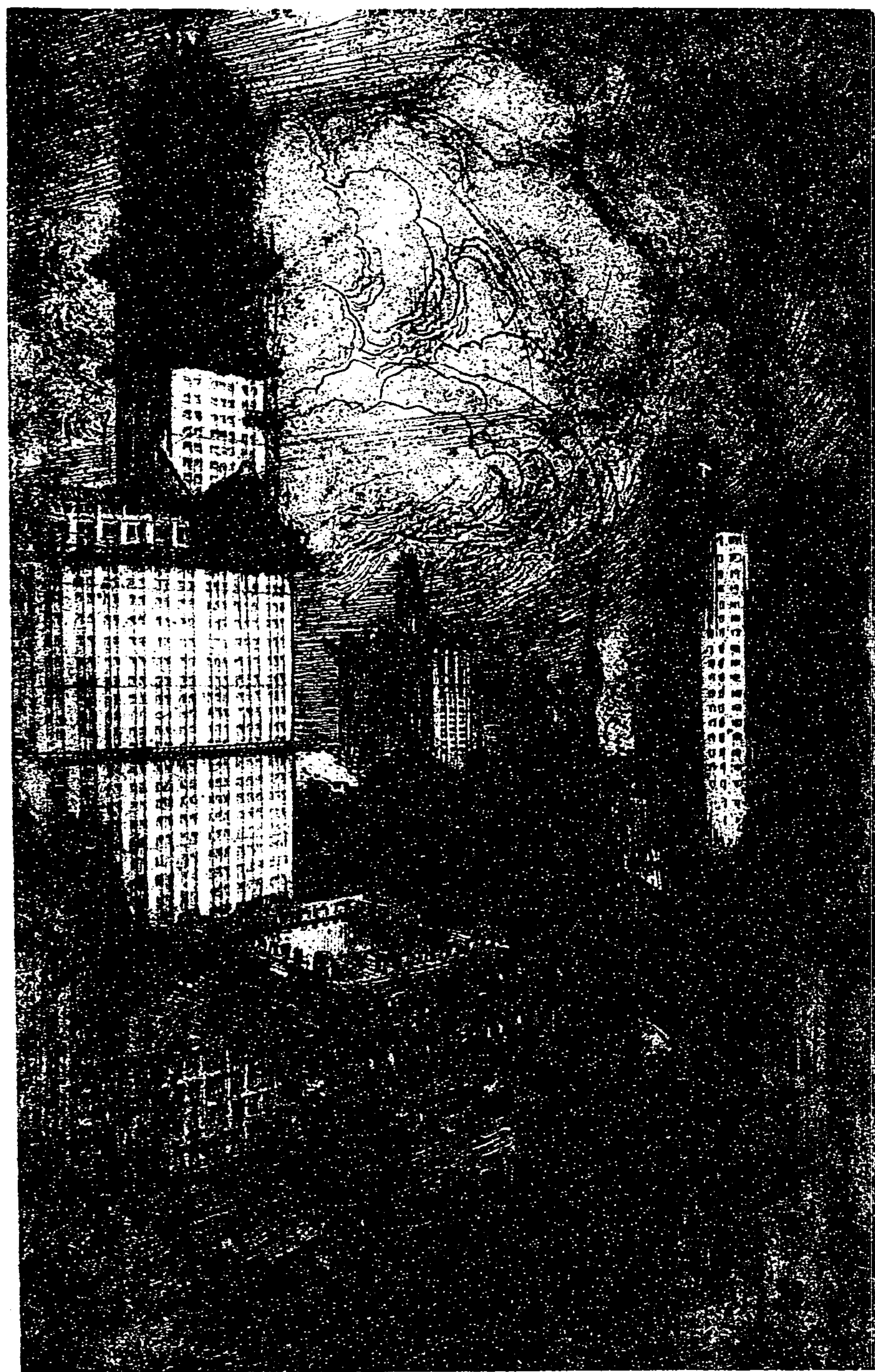
Etching by Martin Lewis.
Courtesy of Kennedy & Co.

leaves the shop, is in its proper position when beams are bolted to columns. Every piece of steel is numbered and frequently bears the mark of the derrick to which it is to be delivered.

TODAY in New York it is almost inevitable that some building, perhaps a landmark, must disappear in a cloud of brick-dust to make way for a new giant. This necessity brings the wrecker to the scene. The pressure of production is such that the builder hardly sees a piece of coping vanish than he anticipates the day when the excavators will set up their shovels. Then he turns his thoughts to the hour when the foundation men will lower the first caisson. And as the cylindrical chambers that become the piers on which the columns

hundred other details that emerge as the building takes its place in the assembly of skyscrapers.

The soil of New York is as full of mystery to the excavator as the depths of the sea are to the diver. To fortify himself against surprises he makes test borings to determine to what extent he will have to deal with loam, sand, quicksand and gravel. In the same manner the foundation man learns how far down he will have to drive his caissons to reach bedrock. The lower and midtown sections of Manhattan, which bear the heaviest skyscraper burden, vary considerably. Downtown, where the smiling houses of the Dutch settlers stood, rock lies from 70 to 100 feet below the street level, while uptown the average depth is about 30 feet. The most hazardous oper-



The Finishing Touches On a Tower. Showing the Woolworth Building, Whose Height Has Only Recently Been Exceeded.

Etching by Frank A. Nankivell.

By VIRGINIA POPE

IT takes longer to build a skyscraper on paper than it does to erect it in steel and clothe it in brick. Each lofty tower brings its own complex problems, all of which must be successfully solved before the actual work of erection can be begun. There is no delay once the building operation is started, for time is money and every day lost is counted in dollars and cents. Prior to that hour when the first gang of workers goes on the job, every detail has been discussed and planned for, from the line on which the excavators must cease to slice away the earth to the smallest lock to be delivered by the hardware manufacturer. So carefully are calculations made that each item fits into the finished scheme as the parts of a jig-saw puzzle fall into place.

The super-tower is the most dramatic expression of twentieth century art. It embodies the spirit of a new age, and draws upon many of our greatest industries. Look behind the completed product, fixed and massive, to examine each of its component parts, and there appears a composite whole that reaches out to every State in the Union and even to foreign countries.

From fifty to sixty trades are involved in the construction of the average skyscraper, and who would dare venture a guess at the number of industries called upon for all the items required? As for human qualities, the slender pile with its skeleton of steel and its curtaining walls of brick, demands the best that mankind has to offer—faith, ingenuity, courage, leadership and vision. The skyscraper has its beginning in that intangible

stuff that dreams are made of. As it takes shape in black and white, the architect begins to be restricted by physical conditions set by the plot of land he has to deal with, by the law and by the financial scope of the undertaking. When the dream has solidified into practicality, he is ready to consult with the engineers.

Plans are drawn, specifications made, schedules worked out. There are field engineers, engineers specializing in foundation work, engineers expert in the use of structural steel, and others who devote themselves to mechanical equipment, such as heating, lighting, telephones and elevators—to say nothing of the consultants who advise and test. When these have turned in their plans and estimates, the generalissimo of the undertaking is summoned—the builder. A few of the large companies are equipped to do much of the construction work themselves, others make a practice of handing it over to sub-contractors.

HOWEVER that may be, it is the builder's function to marshal all the forces, human and material. He must know prices, values, and qualities. With the aid of his assistants he goes over the plans, every detail, from girders to door knobs, coming in for its share of attention. Cost sheets are prepared; sheaves of figures pile up on paper. Products from all parts of the country are taken into consideration. If a dwelling is being built, bathtubs may come from New Jersey; Pittsburgh dealers may furnish the window glass; door trims may be ordered in northern Wisconsin; decorative marbles are quarried from the

flanks of Italy's mountains. Meanwhile, the tower is rising on the blueprints. It already promises to glow with colors—colors suggested by the samples of shining metal, glinting crystal and multi-colored terra-cotta in the architect's office.

It is the perfection of the arrangements during those long months of preparation that puts the miraculous element into skyscraper construction. The clock-like precision with which each trade is timed to appear recalls the regular procession of the apostles around the old clock at Strasbourg. Every rivet hole, punched in the steel before it

rest sink into the ground, he eagerly anticipates the arrival of the initial truckload of steel members.

In anticipation of the hour when the first truck load of structural steel is delivered, the job superintendent anchors his derricks in the solid foundations. He is the most important figure in the field. He captains the movements of men and materials. His is the duty of keeping the steady stream of work flowing uninterruptedly. In his wooden shack he keeps a set of the treasured blue prints, so long in the making. What are hieroglyphics to the outsider are translated to him into beams, conduits, elevator shafts, doors, windows and the

ations are in the lower part of Manhattan.

A few years ago when the New York Telephone Company erected its building on West Street, in the section called Queen's Farm long ago, the builders found that the ground was largely made land, filled in with all sorts of deposit and buttressed with piles of riprap. Through it water seeped as through a sponge; below it was muck and ooze. Notwithstanding these difficulties, engineers found a way to cover an entire city block with a thirty-two-story building. To surmount the obstacles the foundation

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engineers built the equivalent of a rectangular cofferdam, which held the ooze and water in check while the excavation was carried on, twenty-two caissons being used around the margin of the site.

Added to the problems involved in such conditions there is the high cost of real estate in the lower part of Manhattan. In order that approximately \$3,000,000 in rentals, interest charges and taxes might be saved, a brilliant engineering feat was put through last year on the foundations of the new building known as the 40 Wall Street Corporation, whose crystal head has risen above the Woolworth tower. Before the wreckers applied their pick-axes to the roof of the old Manhattan Bank, forced to cede its place to the new giant, the excavators had entered its basement.

Upstairs typists continued to hammer their machines, while in the lower regions drills started to cough. The underpinning of the adjoining structure was well on its way to completion when the demolition of the old walls began. Six weeks later all that was left of the Manhattan Bank were a few timbers and scattered bricks, but the footings that were to support the 110,000-ton steel structure of its successor were nearly ready. The concerted action continued: while the riveters tossed their flaming missiles among the second-floor steel girders, gas-driven trucks were nosing their way into the cavernous regions below, to haul out the muck and rock of the core to make room for subcellars and vault. Four months had been saved.

WHO has not, as a child, built a sand castle on the ocean's beach, seeking bits of driftwood and shiny shells to bolster up its base, and to keep the surrounding sand from drifting? These primitive principles still apply to the building of skyscraper foundations; to prevent the sagging of thoroughfares and the settling of neighboring buildings engineers construct retaining walls and carry shallow foundations to lower depths. In the case of the Irving Trust Company's building at 1 Wall Street one of the busiest of the I. R. T. subway stations was undisturbed by the making of a great hole, seventy feet deep, at its side.

There is, of course, a more or less fixed sequence of operations. As soon as the steel frame goes above the ground, the basement floor concrete arch is started, so that it may serve to stiffen the frame and to take some of the pressure from the retaining walls. When the construction warrants, the arch of the first floor is installed to furnish driveway space and storage room, for the amassing and orderly disposition of materials is one of the essential factors in construction. For this purpose—and also because the law requires it—work begins on the floor arches as each tier of two floors of steel framing is set.

The derrick is always in the vanguard of all operations. How do these gargantuan mechanisms with 80-foot masts and 100-foot booms, capable of lifting twenty-ton loads, keep ahead of the steel they have to hoist? The derrick lifts itself—an acrobatic feat called "jumping the derrick." First the mast is used to raise the boom. Then the boom in turn, after it has been secured on the uppermost ridge of steel, pulls up the mast. Both operations require, of course, man power and the use of tackle.

Each evolutionary stage in the erection of the skyscraper puts the genius of the structural steel engineer to new and exacting tests. New methods of handling steel must be devised and more highly technical ways of dealing with it on the job must be planned. Only a few years ago a section of Times Square had to be roped off when the Paramount Theatre was then being built to permit the unobstructed passage of the colossal parts of the steel trusses that span its audi-

torium, 120 feet in width. The mightiest "traveler" ever used was brought to the site to hoist the steel to a height equivalent to the eighth story.

Specially heavy trusses on columns having tremendous supporting power—some are calculated to hold 1,000 tons each—are used to bridge large open spaces, palatial lobbies or spacious bank rooms, to carry the weight of the superstructure. One can understand how such members, weighing from twenty to forty tons each, can be swung aloft on the end of straining cables; but how, one asks, does a lacy piece of steel like that in the silvery spire of the Chrysler Building climb to its throne, nearly 1,000 feet in the air? Spire and finial combined are 150 feet tall.

That massive steel, which from the street looked like a shred of cobweb hung against the sky, came from the makers in three pieces, and as such made its journey to the sixty-seventh floor. The fire shaft was floored over to receive it. The last of the big derricks to stay on the job was used to fit piece to piece, and then solemnly bore the assembled spire up through the shaft, poised it over a square steel box, and with unwavering certainty lowered it until its base was caught and held. The rest of the story is one of rivets, bolts and fearless men.

All the while steel gangs are still at work hoisting and riveting on a rising structure, corps of other workers are swarming over the unfinished parts. In the lower regions, where the functional organs of the structure are located, water mains are being connected, plumbers and steam fitters are laying and adjusting pipes and preparations are being made for the ventilating apparatus and the complicated electrical system.

The tide of action sweeps upward until the plasterer makes his entrance. He reverses the order and starts from the top down. With him goes the clutter of dirt, carried along by a "mopping up" gang. From then on it is a comparatively short time until the last lap of the race is run. The day comes when the finishing touches are put on like the frills and furbelows on a woman's frock. The marble, so carefully studied in the architect's office, adorns the lobby and crystal or silvery metal is laid upon the soaring pinnacle of the shaft, as if it were a helmet placed upon the head of a knight about to enter the ranks of the new champions.